Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) A method for controlling the quantization in a digital video encoder that comprises a plurality of parallel compression engines, comprising the steps of:

determining a target quantization level for a video frame;

wherein the video frame is represented by a plurality of panels, each panel comprises a plurality of slices, and each panel is processed in parallel by a respective one of the compression engines;

encoding the first slice of each panel in accordance with said target quantization level; and

encoding subsequent slices in each panel in accordance with a quantization level that is allowed to vary from said target quantization level until the last slice of each panel is reached;

wherein the quantization level used for encoding the last slice of each panel is driven toward said target quantization level.

2. (Original) A method in accordance with claim 1 wherein said driving step uses piecewise linear feedback to drive the quantization level of the last slice of each of said image panels toward said target quantization level.

3. (Original) A method in accordance with claim 2 wherein said feedback avoids abrupt variations in the quantization level between the first and last slice of each of said image panels.

4. (Original) A method in accordance with claim 1 wherein a group of pictures (GOP) target bit rate is adjusted based on a number of film pictures and non-film pictures currently in a processing pipeline of at least one of said compression engines.

5. (Original) A method in accordance with claim 4 wherein a higher target bit rate is provided for non-film pictures.

6. (Original) A method in accordance with claim 1, wherein:
the quantization level used for encoding the last slice of each panel is driven toward said target quantization level such that the first slice and the last slice of each panel are encoded in accordance with approximately the same quantization level.

7. (Original) A method in accordance with claim 1 wherein a buffer level of said video encoder is used to control the start of a new group of pictures (GOP).

8. (Original) A method in accordance with claim 1 wherein said panels are simultaneously compressed at the respective compression engines during a frame time.

9. (Original) A method in accordance with claim 8 wherein the compressed panel data are stored locally at the compression engines for subsequent transfer to a video buffer of the video encoder within a next frame time.

10. (Original) A method in accordance with claim 9 wherein data are retrieved from said buffer, to form a transport packet, at an average rate equal to a specified video bit rate whenever the buffer has at least one transport packet payload's worth of data.

11. (Original) A method in accordance with claim 10 wherein null packets are substituted for video packets to maintain a constant transport bit rate whenever said buffer level falls below one transport packet payload's worth of data.

12. (Original) A method in accordance with claim 7 wherein a reference quantizer scale is calculated for each of said compression engines.

13. (Currently amended) A method in accordance with claim 12 wherein the reference quantizer scale for a compression engine is calculated based on:

the target quantization level,

an accumulation of quantizer scale values for ~~that~~ each compression engine (sum_quant),

an accumulation of the number of bits generated on ~~that~~ each compression engine (bitcount);

an accumulation of the number of macroblocks processed on ~~that~~ each compression engine (MBcount); and

a fullness level of a video buffer of the video encoder (buffer_level).

14. (Original) A method in accordance with claim 13 wherein the compression engine modifies its reference quantizer scale based on a local buffer fullness to generate a final quantizer scale value for use in quantization.

15. (Original) A method in accordance with claim 14 wherein a panic mode is initiated by the compression engine if the final quantizer scale value is higher than a predetermined maximum value, said panic mode maintaining the quantization at or below said predetermined maximum value.

16-26. (Cancelled).

27. (Original) Apparatus for controlling the quantization in a digital video encoder that comprises a plurality of parallel compression engines, comprising:

means for determining a target quantization level for a video frame;

wherein the video frame is represented by a plurality of panels, each panel comprises a plurality of slices, and each panel is processed in parallel by a respective one of the compression engines;

means for encoding the first slice of each panel in accordance with said target quantization level; and

means for encoding subsequent slices in each panel in accordance with a quantization level that is allowed to vary from said target quantization level until the last slice of each panel is reached; and

means for driving the quantization level at the last slice of each of said image panels toward said target quantization level.

28-30. (Cancelled).

31. (New) A method in accordance with claim 1, further comprising:

computing said target quantization level based on a complexity estimates from a number of past frames, wherein:

a complexity value of the most recently encoded I-frame is used as the complexity estimate for a current I-frame;

an average of the complexity values of the four most recently encoded P-frames are used as the complexity estimate for a current P-frame; and

an average of the complexity values of the four most recently encoded B-frames are used as the complexity estimate for a current B-frame.

32. (NEW) A method in accordance with claim 31, wherein:

a P complexity queue stores the complexity values of the four most recently encoded P-frames; and

a B complexity queue stores the complexity values of the four most recently encoded B-frames.

33. (New) A method in accordance with claim 32, wherein:

in the event that the current frame to be encoded is a first I-frame or P-frame after one of a scene change or a fade-in from black, the I-frame complexity estimate and the complexity values stored in the P and B complexity queues are conditionally replaced by corresponding I, P, and B default startup complexity estimates.

34. (New) A method in accordance with claim 32, further comprising:

comparing the stored values in the P and B complexity queues and the I complexity estimate with the corresponding I, P, or B default startup complexity value;

replacing the stored complexity value with the corresponding P and B default startup complexity value in the event that the stored complexity value is less than the corresponding default startup complexity value;

replacing the I complexity estimate with the corresponding I default startup complexity value in the event that the I complexity estimate is less than the corresponding default startup complexity value.

35. (New) A method in accordance with claim 32, further providing:

multiplying the stored complexity values of the P and B complexity queues with a constant greater than 1 in order to increase the P and B complexity estimates where the current frame is a first frame after a fade-out to black has been detected;

multiplying the I complexity estimate by a constant less than 1 in order to reduce the I complexity estimate for every I frame during a fade-out to black.

36. (New) A method in accordance with claim 9, wherein:

the encoder buffer is a central buffer for the video encoder; and

the buffer fullness level of the video encoder is provided by the sum of the levels of the encoder buffer and levels of local buffers at each compression engine.

37. (New) A method in accordance with claim 36, further comprising:

setting a target buffer fullness level at the start of every GOP.

38. (New) A method in accordance with claim 37, wherein:

the buffer fullness level is driven to the target buffer fullness level using feedback control at the start of every GOP.

39. (New) A method in accordance with claim 31, further comprising:

determining a target number of bits to be generated during encoding of each group of pictures (GopTarget);

determining a target number of bits to be generated during encoding of each frame (FrameTargetBits); and

allocating the GopTarget bits among each frame in the group of pictures in proportion to the complexity estimates for each frame.

40. (New) A method in accordance with claim 39, further comprising:

scaling the complexity estimates for each frame by a corresponding weighting factor to account for different perceptual and statistical characteristics between I, P, and B frames.

41. (New) A method in accordance with claim 39, further comprising:

bounding the FrameTargetBits to a fraction of a maximum allowable number of bits for the frame to avoid panic mode.

42. (New) A method in accordance with claim 1, further comprising:

setting a lower bound for the target quantization level for P and B frames if the quantization level for the current P or B frame is lower than a previous quantization level for a corresponding P or B frame.

43. (New) A method in accordance with claim 1, further comprising:

delaying the encoding of a new Group of Pictures (GOP) if there is insufficient space in an encoder buffer to accommodate an I frame.

44. (New) A method in accordance with claim 1, further comprising:

determining a maximum number of bits encoding of the current frame is allowed to generate (FrameMaxBits);

initiating a panic mode in the event that FrameMaxBits falls below a threshold, said panic mode allowing a graceful degradation in video quality.

45. (New) A method in accordance with claim 44, wherein:

in the event that FrameMaxBits falls below a first threshold, non-intra DC coefficients are preserved during panic mode encoding, while all other DCT coefficients are dropped.

46. (New) A method in accordance with claim 45, wherein:

in the event that FrameMaxBits falls below a second threshold which is lower than said first threshold, the magnitude of the non-intra DC coefficients is scaled to reduce the magnitude of the non-intra DC coefficients.

47. (New) A method in accordance with claim 46, wherein:

in the event that FrameMaxBits falls below a third threshold which is lower than said second threshold, all DCT coefficients are dropped, including non-intra DC coefficients.